

CLAIMS

1. A contrast-enhanced angiography for taking an image of a blood vessel in an object to be examined with injection of a contrast agent by using a magnetic resonance imaging system, the angiography comprising the steps of:

(a) positioning a desired region of said object, including said blood vessel, within a static magnetic field space;

(b) injecting the contrast agent into said object;

(c) imaging said desired region in accordance with a predetermined pulse sequence including at least one imaging parameter;

(d) reconstructing a blood vessel image from imaging data obtained in said imaging step; and

(e) displaying said blood vessel image,

wherein, in said imaging step (c), a value of the at least one imaging parameter in said pulse sequence is changed during the imaging depending on a concentration of the contrast agent in said blood vessel.

2. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

wherein, in said imaging step (c), a first period and a second period are set depending on the concentration of the contrast agent, and said imaging parameter has different values during said first period and said second period.

3. The contrast-enhanced angiography for use with the

magnetic resonance imaging system according to Claim 2,

wherein, in said imaging step (c), at least two imaging parameters are selected, and a different imaging parameter for said first period and said second period is respectively selected.

4. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 3,

wherein a value of a first imaging parameter is changed during said first period, and a value of a second imaging parameters is changed during said second period.

5. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 2,

wherein said first period is a concentration increasing period until a time at which the concentration of the contrast agent is peaked, and said second period is a concentration decreasing period after the time at which the concentration of the contrast agent is peaked.

6. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 4,

wherein said first period is a higher concentration period in which the concentration of the contrast agent is not lower than a threshold, including the time at which the concentration of the contrast agent is peaked, and

said second period is a lower concentration period in which the concentration of the contrast agent is lower than

the threshold.

7. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 5, wherein said pulse sequence is a gradient echo pulse sequence including a flip angle and a repetition time as said imaging parameters,

a value of at least one of the flip angle and the repetition time is changed,

the flip angle is increased following a concentration increase during said concentration increasing period and reduced following a concentration decrease during said concentration decreasing period, and

the repetition time is reduced following the concentration increase during said concentration increasing period and increased following the concentration decrease during said concentration decreasing period.

8. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 6,

wherein said pulse sequence is a gradient echo pulse sequence including a flip angle and a repetition time as said imaging parameters,

said first imaging parameter is one of the flip angle and the repetition time, and said second imaging parameter is the other,

the flip angle is set such that the flip angle has a larger value during said higher concentration period than a

value during said lower concentration period, and

the repetition time is set such that the repetition time has a shorter value during said higher concentration period than a value during said lower concentration period.

9. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 8,

wherein the value of said first imaging parameter is changed in opposite directions before and after the peak time, and the value of said second imaging parameter is monotonously increased or reduced.

10. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claims 7 to 9,

wherein the flip angle is changed such that the flip angle becomes an Ernst's angle, and

the repetition time is changed such that the flip angle becomes an Ernst's angle.

11. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

wherein said displaying step (e) displays statistic values obtained based on values resulting from changing the value of said imaging parameters.

12. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

wherein, in said imaging step (c), data regarding a

central portion of a k-space is obtained near a time at which the concentration of the contrast agent is peaked.

13. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

further comprising, at any point in time between said positioning step (a) and said reconstructing step (d),

(f) imaging said desired region in accordance with the same pulse sequence as that used in said imaging step (c),

wherein, in said reconstructing step (d), said blood vessel image is obtained from difference between images taken in said two imaging steps (c) and (f).

14. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

further comprising, between said positioning step (a) and said injecting step (b),

(g) injecting the contrast agent into said object and obtaining information regarding changes in the concentration of the contrast agent in said blood vessel,

wherein, in said imaging step (c), start of said step (c) is instructed and the value of said imaging parameter is changed in accordance with the concentration change information.

15. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

further comprising, between said injecting step (b) and

said imaging step (c),

(h) successively taking monitoring images of said desired region including said blood vessel and instructing start of said imaging step (c),

wherein the start instruction is issued when a signal representing information regarding the concentration of the contrast agent in said blood vessel is extracted from said monitoring images and said extracted signal exceeds a predetermined value.

16. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

wherein, in said imaging step (c), values of different kinds of imaging parameters are changed during the imaging.

17. The contrast-enhanced angiography for use with the magnetic resonance imaging system according to Claim 1,

wherein, in said imaging step (c), a manner of changing the value of said imaging parameter is modified during the imaging.

18. A magnetic resonance imaging system comprising:

static magnetic field generating means (2) for applying a static magnetic field to an object to be examined(1);

gradient magnetic field generating means (3) for applying a gradient magnetic field;

RF magnetic field transmitting means (5) for irradiating, to nuclear spins within said object, RF

magnetic field pulses to cause nuclear magnetic resonance of the nuclear spins;

an echo signal receiving means (6) for detecting an echo signal emitted by the nuclear magnetic resonance;

pulse sequence control means (4) for controlling a pulse sequence including at least one imaging parameter and executed to receive the echo signal;

signal processing means (8) for reconstructing an image of a blood vessel by using the echo signal detected by said echo signal receiving means (6); and

display means (20) for displaying said blood vessel image,

wherein, during execution of said pulse sequence, said pulse sequence control means (4) changes a value of the at least one imaging parameter in said pulse sequence depending on a concentration of a contrast agent , which has been injected into said object, in said blood vessel.

19. The magnetic resonance imaging system according to Claim 18,

wherein said signal processing means (8) estimates the concentration of the contrast agent based on information regarding changes in the concentration of the contrast agent , the information being obtained in advance, and

said pulse sequence control means (4) takes said blood vessel image in accordance with a predicted value of the concentration of the contrast agent.

20. The magnetic resonance imaging system according to Claim 19,

further comprising an input unit for receiving an input to instruct start of the imaging of said blood vessel image,

wherein said pulse control means (4) successively takes monitoring images including said blood vessel,

said display means (20) successively displays said monitoring images, and

said pulse sequence control means (4) switches over the imaging from said monitoring images to said blood vessel image in accordance with the start instruction.

21. The magnetic resonance imaging system according to Claim 18,

further comprising contrast agent injecting means, said contrast agent being injected by said contrast agent injecting means.